

APPLICATION FOR  
UNITED STATES LETTERS PATENT  
SPECIFICATION

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Title of the Invention: NETWORK SYSTEM HAVING FUNCTION OF  
RETRIEVING INFORMATION, NETWORK  
TERMINAL DEVICE HAVING FUNCTION OF  
RETRIEVING INFORMATION, AND NETWORK  
RELAY DEVICE HAVING FUNCTION OF  
RETRIEVING INFORMATION

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NETWORK SYSTEM HAVING FUNCTION OF RETRIEVING  
 INFORMATION, NETWORK TERMINAL DEVICE HAVING  
 FUNCTION OF RETRIEVING INFORMATION, AND NETWORK  
 RELAY DEVICE HAVING FUNCTION OF RETRIEVING  
 5 INFORMATION

### Background of the Invention

#### Field of the Invention

The present invention relates to a technology  
 10 of locating information and a technology of  
 obtaining information in a service, in which various  
 information is obtained through a network,  
 represented by the World Wide Web (WWW) service of  
 the Internet.

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#### Description of the Related Art

The conventional communications technology  
 provides a system of establishing communications  
 by specifying a subject (a person, a communications  
 20 device, a computer, etc.). Therefore, a user  
 performs the following processes through a network  
 as shown in FIG. 1 to obtain necessary information.

\* checking (retrieving) necessary  
 information in the network; and

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\* obtaining (transferring) the

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information from a computer storing the information through a relay device in the network

In the above mentioned method, the quality of a retrieval result (quality of obtained information, accessibility through a network, etc.) largely depends on the ability of a user. Therefore, for example, necessary information may be inefficiently transferred from a remote place without knowing that it is also located close to a user in a network (that is, stored in a place accessible in transfer or at a high speed). Such inefficiency brings not only a disadvantage to a user but also heavy load to the network and the computer, thereby bringing disadvantages to the entire system.

As a conventional technology developed to solve the above mentioned problem, a retrieval service (a search engine, for example, 'YAHOO as a service of the Internet') is used in a retrieving process, and an agent service (a proxy service) is used in a transferring process.

A retrieval service relates to a database system, and retrieves an address in a network of computers containing information related to a keyword assigned by a user, and returns the result.

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The user determines a computer having necessary information based on a plurality of retrieval results, and requests the computer to transfer the information.

5           An agent service is also referred to as a cache service. That is, the information previously transferred by a user is cached for a predetermined period, and the cached information can be transferred without issuing a request to the  
10 destination computer when the second and subsequent requests to transfer the information are issued. If the user can be provided with an agent service in the neighborhood in the network, the above mentioned inefficiency of transferring the  
15 information from a remote computer in the network can be avoided.

          However, in the conventional technology described above, a retrieval and a transfer are performed independently of each other, there is an  
20 inefficiency which can not be avoided.

          For example, although a database of the retrieval service is updated frequently, a computer containing network addresses obtained through the retrieval results may store no information at all,  
25 or a computer containing the network addresses may

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of a transfer mechanism.

### Summary of the Invention

The present invention aims at realizing an  
5 information transfer mechanism having (all or a part  
of) an incorporated retrieval mechanism.

The present invention is based on a network  
system which communicates with a network device  
storing information or other objects.

10 An information network address unit (user  
mechanism) assigns an information network address,  
which is a network address, to the name of  
information or an object.

An information retrieval communications unit  
15 (communications mechanism and relay mechanism)  
establishes communications using an information  
network address for a corresponding network device  
storing information or an object.

With the above mentioned configuration  
20 according to the present invention, the information  
network address unit can be designed to include an  
information network address generation unit  
(information network address mechanism) for  
receiving information representing the feature of  
25 information or an object, and outputting an

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information network address. The information network address generation unit includes, for example, an operations unit (operations mechanism) for generating an information network address by operations. Furthermore, the operations unit performs operations on an error detection and correction code such as a CRC, etc. Otherwise, the operations unit performs operations on a secure hash function such as an MD5, etc. The above mentioned information network address generation unit includes a database accumulating correspondence between information or an object and an information network address, and generates an information network address by searching the database. Furthermore, the database is, for example, a server of a domain system in which a record type indicating the name of information or an object is added. The information network address generation unit inquires the server of an information network address corresponding to the name of the information or the object. The database can also be a plurality of WEB search engine system, and the information network address generation unit inquires the retrieval system of uniform resource locator information to generate an information network

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  $\text{C}_{60}$  molecule is a truncated icosahedron,
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 12 of which are pentagons and 20 are hexagons.
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communications unit can be designed to establish communications using an information network address through an existing communications mechanism for a network address already existing as an information network address.

Furthermore, the above mentioned information retrieval communications unit can be designed to assign an information network address to an existing anycast address, multicast address, or broadcast address.

#### **Brief Description of the Drawings**

The features and advantages of the present invention will be more clearly appreciated from the following description taken in conjunction with the accompanying drawings in which like elements are denoted by like reference numerals and in which:

FIG. 1 shows the process of retrieving and transferring information in the conventional technology;

FIG. 2 shows the entire configuration of the system according to an embodiment of the present invention;

FIG. 3 shows the configuration of a user mechanism;

FIG. 5 shows the configuration of a relay mechanism (routing mechanism);

FIG. 7 shows the assignment of an IPv4 address;

10           FIG. 9 shows an example of the configuration  
of the route table using information network  
addresses;

15           FIG. 11 shows a packet process of a relay  
mechanism.

Embodiments of the present invention are  
20 described below in detail by referring to the  
attached drawings.

Normally, a network address is information for communications (for example, a transmission of a packet) through a network, and is used when a relay  
25 mechanism in the network, which transmits

information between a communications device and another communications device, determines the transfer destination of a packet.

Therefore, a network address indicates the position and the identification name of a communications device in a network. For example, a MAC (media access control) address used in Ethernet is an identification name uniquely identifying the network interface in Ethernet. An IP (Internet protocol) address used in Internet is an identification name uniquely identifying the host connected to Internet. Internet has a mechanism for transferring an IP packet according to the unique identification name, and the mechanism performs communications between hosts. A host refers to a device connected to a network, and functions as an end point of communications. Normally, it is a computer. On the other hand, a router mechanism and a relay mechanism do not function as end points themselves, but are fundamentally used to relay a communications packet between hosts. A network device refers to a communications device comprising a host, a router mechanism, and a relay mechanism.

According to the present invention, to incorporate (all or a part of) a retrieval mechanism

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into a relay mechanism, an information network address is installed as a new type of network address.

An information network address is an  
5 identification name of information and an object,  
and is different from the conventional network  
address.

\* First, an information network address is  
an identification name of specific information or  
10 object, and does not uniquely specify a host.

\* Next, an information network address  
specifies a host holding the information or object.  
If one host holds plural pieces of information, the  
host has a plurality of information network  
15 addresses. If a plurality of hosts have the same  
information, the hosts have the same information  
network addresses.

If the above mentioned information network  
address is assumed, a transfer mechanism containing  
20 (all or a part of) a retrieval mechanism can be  
realized.

As described above, inevitable inefficiency  
arises in the conventional technology because a  
retrieving process is performed independent of a  
25 transferring process. This problem can be solved

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as described below by installing the information network address.

First, a retrieval service for checking the correspondence between information and a network address is not required. Therefore, a user is free from an operation of obtaining a network address through the retrieval service. Since an information network address specifies the host containing corresponding information, a host accessed by a user using an information network address necessarily contains information. If communications cannot be established using an information network address, it means that the information exists nowhere in the network. When the configuration or the position of a host is changed, the change information can be transmitted as route information to a routing mechanism. Therefore, the user can access the optimum host (nearest host or less expensive host in cost) in the network. In addition, if a destination host becomes down during the transfer of information, or if the network becomes faulty, the information can be transferred with the faulty host replaced with another host accessible and containing the same information. Since the flow of information can be

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grasped and the latest information can be constantly located (the destination of a packet addressed to the information network address) by monitoring the information network address of a packet trasferred  
5 through a network, the user can transfer the information from the optimum host with little attention.

FIGS. 2 through 5 show the configuration of the system for realizing the above mentioned  
10 functions according to an embodiment of the present invention.

First, FIG. 2 shows the configuration of the entire system according to an embodiment of the present invention.

15 A network 101 comprises a user mechanism 102, a host 104 containing information, a relay mechanism 103, etc.

The user mechanism 102 converts a character string, an image, voice, and other numeric data  
20 having an optional length representing 'information' input as a communications target into a uniquely corresponding information network address, and transmits a packet storing the information network address to the network 101.

25 Upon receipt of the packet from the user

mechanism 102, the relay mechanism 103 in the network 101 determines the route to the host 104 containing the information corresponding to the information network address stored in the packet, and relays the packet.

Upon receipt of the packet from the relay mechanism 103, the host 104 stores the information corresponding to the information network address stored in the packet in a return packet having a network address corresponding to the user mechanism 102 as a destination address, and transmits it to the network 101.

Upon receipt of the return packet from the host 104, the relay mechanism 103 determines the route to the user mechanism 102 corresponding to the network address stored in the return packet, and relays the return packet.

Upon receipt of the return packet from the relay mechanism 103, the user mechanism 102 receives the information stored in the return packet.

FIG. 3 shows the configuration of the user mechanism 102 shown in FIG. 2.

A information network address mechanism 201 converts a character string, an image, voice, and other numeric data having an optional length

representing 'information' input as a communications target into a uniquely corresponding information network address.

A communications mechanism 202 generates a packet storing the above mentioned information network address and other communications information, transmits it to the network 101, or receives a packet from the network 101 and extracts information from the packet.

FIG. 4 shows the configuration of the information network address mechanism 201 shown in FIG. 3.

An operations mechanism 301 computes a unique value for determination of an information network address from a character string, an image, voice, and other numeric data having an optional length representing 'information' input as a communications target.

An adjustment mechanism 302 adjusts the length and expression of the computation result output from the operations mechanism 301 such that it can be allotted to a part or all of an existing network address.

An information network address generation mechanism 303 generates an information network

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FIG. 5 shows the configuration of the relay  
5. mechanism (routing mechanism) 103 shown in FIG. 2.

An information address detection mechanism  
402 detects a network address and an information  
10 network address from a received packet.

The communications mechanism 406 transmits again a packet transferred from the communications mechanism 401 to the network 101 shown in FIG. 2.

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according to the present invention with the above mentioned configuration.

First described is the details of an information network address.

5 First, a 'network address' refers to an address used in a network layer (OSI layer 3). A typical example of this type of address can be an IP address in an Internet protocol. Although it is not a common technical term, an 'information address' is used  
10 in Japanese corresponding to the URL (uniform resource locator (refer to RFC1738)). Since the present invention suggests an 'address indicating information' as an address (network address) of a network layer, an 'information network address' is  
15 used to clarify the difference from the 'information address'.

An information network address can be realized by assigning a portion used as the information network address to a part of an existing network  
20 address. In an IPv4 (Internet protocol version 4 (refer to RFC0791)), an address is represented by 32 bits. If 24 bits in the 32 bits are assigned to an information network address, it can be used as an information network address of the information  
25 of 224 (about 16 million) types. In the IPv6

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(Internet protocol version 6 (refer to RFC2460)),  
 an address is represented by 128 bits. Assuming  
 that a half of the bits are used for an information  
 network address, 264 (4 billion multiplied by 4  
 5 billion), that is, infinite information network  
 addresses can be provided. It is obvious that an  
 address system independent of a network address can  
 be defined. In this case, however, the relay  
 mechanism 103 in the network 101 has to refer to  
 10 an information network address as well as a network  
 address.

FIG. 6 shows the configuration of data of an  
 IPv4 header.

A data field relating to the present invention  
 15 can be, for example, a SOURCE IP ADDRESS field, a  
 DESTINATION IP ADDRESS field, and an IP OPTIONS field.  
 The SOURCE IP ADDRESS field is a source address of  
 a packet having the header. The DESTINATION IP  
 ADDRESS field is a destination address of a packet  
 20 having the header. The IP OPTIONS field is an area  
 for realizing an option function defined  
 separately.

The address of an IPv4 is 32 bits in length,  
 and is prescribed as shown in FIG. 7.

25 For example, the address space of class E is

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5 information network address.

10 requirement, and several pieces of information  
which may be different at a certain probability can  
have the same information network addresses.

number assigned to a book under management of a publisher. By assigning the number as is to an information network address, an information network address of a book can be obtained. However, since the management of numbers are left to a publisher, the same numbers can be assigned to others. Therefore, the number can be used double. However, from the viewpoint of searching for information, the numbering is effective enough.

25 addresses assigned in a certain method, but an

information network address having a given length can also be computed from optional information otherwise featuring information. The operations mechanism 301 shown in FIG. 4 provides the function.

5           For example, the operations mechanism 301 computes an error detection code in the CRC (cyclic redundancy check) system, etc. from data indicating given information. Normally, an error detection code in the CRC system, etc. is used to detect whether  
10           or not an error such as an irregular bit, etc. has occurred during the transmission of data. Based on that a different error detection code is assigned to each piece of data, an error detection code can be used to compute a short numeric string as an  
15           information network address from information of any length featuring information.

          Otherwise, the operations mechanism 301 computes an information network address using a secure hash function from data indicating given  
20           information. For example, an MD 5 algorithm (message digest 5 (refer to RFC1321)) obtains an operation result of 128 bits by performing predetermined computation on original text of any length. This algorithm defines a computing method  
25           such that there is a very small possibility that

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FIG. 4 shows an example of the configuration in which the information network address mechanism 201 shown in FIG. 3 is realized as a mechanism for computing an information network address in an operation. On the other hand, it is also possible to design the information network address mechanism 201 such that a database accumulating correspondence between information and an information network address can be provided, in which an information network address is not obtained in an operation, but an information network address of the information can be obtained by searching the database.

Practically, the information network address mechanism 201 can be designed to obtain an information network address using a domain name system (DNS (refer to RFC1591)) widely used through Internet as a network address database. In the DNS, the address information of a network device can be defined and referred to according to a plurality of attributes. For example, an A record refers to an IPv4 address, an AAAA record refers to an IPv6 address. The network device can have both IPv4 and IPv6 addresses, and necessary address information can be obtained when a record is specified for

reference. Then, as the information network address mechanism 201, a record type indicating the name of information or an object is added to the DNS server, and the DNS server is inquired. Thus,  
5 an information network address corresponding to the name of information or an object can be obtained.

Otherwise, the information network address mechanism 201 can also be designed to utilize the WWW (world wide web) retrieval engine to obtain an  
10 URL (uniform resource locator (uniform resource locator (refer to RFC1738))), and generate an information network address from the URL.

The 'Information Address Converting method, Information Address Conversion Apparatus, and  
15 Information Retrieval System' described in the Japanese Patent Publication No.9-3219633 (hereinafter referred to as a reference) is known as a similar technology. The difference between the reference and the present invention is described  
20 below.

The reference has the following features.

- \* An information address such as an URL address, etc. comprising a character, a value, and a symbol string is converted into a short numeric string.
- 25 \* A compressed code system (Huffman code,

arithmetic operation code) is used as a conversion system.

\* Information can be easily retrieved by a simple apparatus and operation by specifying an information address using a short numeric string.

The present invention suggests a system of obtaining a 'network address' from a character string indicating information, and is different in purpose and condition from the reference in which any format of 'numeric code' is obtained to 'easily retrieve information'.

First, the present invention aims at newly installing an 'information network address' to be used as a 'network address', and simultaneously performing a retrieving and transferring processes while the reference simply aims at retrieving information.

Relating to deriving a 'short numeric string' from a 'symbol string indicating information', the reference and the operations mechanism 301 and the adjustment mechanism 302 (shown in FIG. 4) of the present invention have fundamentally the same objects. However, according to the present invention, a derived 'short numeric string' is used as a part of a 'network address', which is different

5           Finally, the present invention is different from the reference in a unit for actually deriving an address. The reference uses the compressed code system only, but the present invention uses not only the operations system, such as an error detecting  
10 operation, a secure hash function, etc., quite different from that of the reference, but also a system using a database. Thus, the present invention is quite different from the reference in realization system.

Then, the relay mechanism 103 (FIG. 2) in the  
25 system according to the present embodiment of the

present invention stores the route table 404 using an information network address in addition to the route table 403 using a conventional network address as shown in FIG. 5. The transfer instruction mechanism 405 in the relay mechanism 103 refers to the route table 403 using a network address based on the network address detected by the information address detection mechanism 402, and refers to the route table 404 using an information network address based on the information network address detected by the information address detection mechanism 402, thereby transferring the packet received by the communications mechanism 401 to the communications mechanism 406 corresponding to an appropriate route.

FIG. 8 shows an example of the configuration of the route table 403 using a network address. FIG. 9 shows an example of the configuration of the route table 404 using an information network address.

Various configurations of the route table 404 using an information network address can be listed, but essentially required are the following items.

\* Information specifying an 'information route' of an information network address, a group of information network addresses, etc.

- \* a relayed-to link address
- \* metric value (distance)
- \* state information

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An 'information route' corresponds to the  
5 'route' specified by a network address and the mask  
(shown in FIG. 8) of the network address in the route  
table used by a normal router. The transfer  
instruction mechanism 405 (shown in FIG. 5) in the  
relay mechanism 103 determines whether or not the  
10 destination address of the received packet is a part  
of the address or the address group specified by  
the item. If a matching result is output, the  
transfer instruction mechanism 405 transfers the  
packet to a corresponding 'relayed-to link  
15 address'.

Normally, a plurality of 'information routes'  
can be applied to one information network address.  
In this case, the optimum route can be selected using  
a 'metric value (distance)' as an index. A similar  
20 mechanism is used in a common route table (FIG. 8),  
and the metric value is dynamically adjusted to  
obtain the optimum route. Since route control using  
a metric value is a well-known technology, it is  
not explained in detail here.

25 In an information route, a packet is not

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of a route table in the latest state in the network by notifying each other of a change in a route between relay mechanisms.

It is inquired whether or not information  
5 identified by the URL is stored among the WWW agent server. If it is stored, the information is normally transmitted by an ICP (Internet cache protocol (refer to RFC2186/2187)). When an agent  
10 server does not store the information identified by the URL, it requests the final host identified by the URL to transfer the information, or inquire of another agent server whether or not the information identified by the URL is stored. If  
15 yes, the agent server is requested to transfer the information.

A similar means can be applied in the management of a route of an information network address.

FIG. 10 shows the operation of updating the  
20 route table 404 using an information network address specific to the present invention.

The communications mechanism 401 (shown in FIG. 5) in the relay mechanism 103 checks the information network address of the packet received  
25 from the network 101, and has the 'information route'

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managed on the route table 404 using an information network address reflect the address according to a predetermined discrimination standard. When the source address information stored in the packet is an information network address, it is assumed that the host 104 (FIG. 1) storing the information identified by the information network address is located in the link area where the packet has arrived. Thus, appropriate adjustments can be automatically made corresponding to a change in network state by updating the 'information route' of the route table 404 using an information network address according to the source address information.

Thus, according to the present invention, assuming that the host 104 which transmits 'information' is located around the area of the source address of a relay packet (in the direction of receiving the relay packet), the route table 404 using an information network address is managed based on a source address, which is the novelty of the present invention.

FIG. 11 shows a packet process performed by the relay mechanism 103.

In FIG. 11, the relay mechanism 103 receives a management packet in addition to a normal relay

packet. A management packet is used for update management of the route table 404 using an information network address, and is communicated between relay mechanisms 103.

5 First, in the packet reception waiting process in step 1, the relay mechanism 103 waits for the receipt of a packet from the network 101. When a relay packet is received, the relay mechanism 103 performs the process in step 2. When a management  
10 packet is received, it performs the information routing process in step 3.

In the packet receiving process (when a relay packet is received) in step 2, the relay mechanism 103 checks the destination address. If the address  
15 is an information network address, the relay mechanism 103 performs the information route relaying process in step 2-1. If the address is a normal network address, it performs the normal route relaying process in step 2-2.

20 The relay mechanism 103 searches the route table 404 (FIG. 5) using an information network address in the information route relaying process (when the destination address is an information network address), determines the optimum route, and  
25 transmits the packet through the determined route



address of the relay packet in the source address checking process in step 3-2. If the address is an information network address, the relay mechanism 103 performs the information route updating process in step 4. If the address is a normal network address, it returns the packet reception waiting process in step 1.

The relay mechanism 103 updates the route table 404 using an information network address for the information route in the direction of the link through which the relay packet is received in the route updating process in step 4. Then, the relay mechanism 103 returns to the packet reception waiting process in step 1.

In addition to the above mentioned embodiment, the present invention can be designed to establish communications using an information network address without setting an information network address route by using an existing communications mechanism for an existing network address used as an information network address.

Furthermore, the present invention can be designed to use an existing communications mechanism as is by assigning an information network address to a conventional anycast address (refer

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While the invention has been described with reference to the preferred embodiments thereof, various modifications and changes may be made to those skilled in the art without departing from the true spirit and scope of the invention as defined by the claims thereof.

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